05059500 SHEYENNE RIVER AT WEST FARGO, ND--Continued

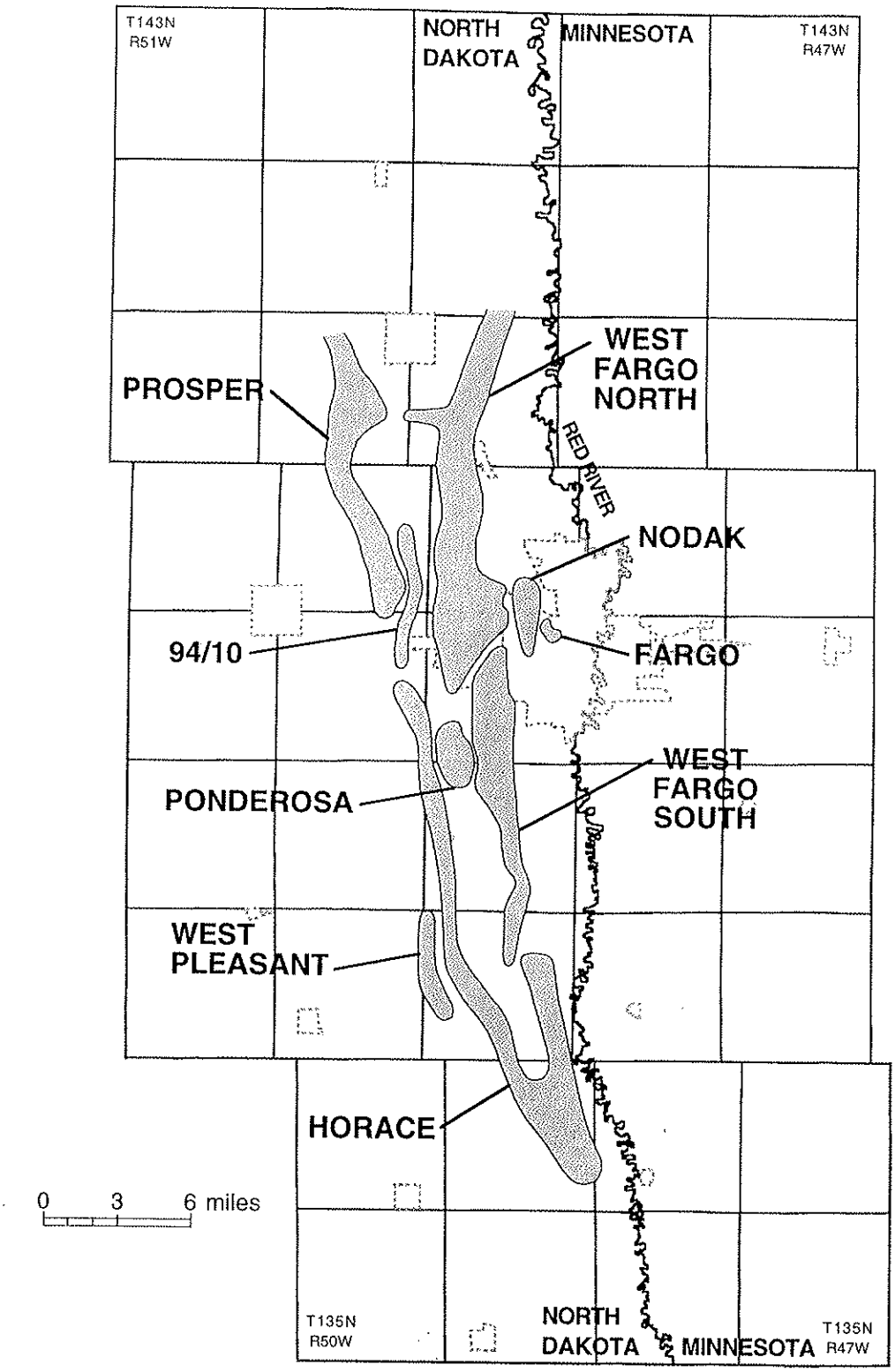
Probability of annual high discharges, post-regulation period

[ng, statistic not given]

Exceedance probability	Recurrence interval (years)	Maximum instantaneous (ft^3/s)	Maximum average discharge (ft^3/s)			
			3-day period	7-day period	15-day period	30-day period
0.99	1.01	124	85.6	75.4	67.2	57.2
0.95	1.05	264	210	186	158	128
0.90	1.11	383	324	287	242	191
0.80	1.25	586	526	470	391	305
0.50	2	1,220	1,180	1,070	902	698
0.20	5	2,310	2,270	2,130	1,860	1,470
0.10	10	3,100	3,030	2,890	2,600	2,110
0.04	25	4,130	3,960	3,860	3,600	3,020
0.02	50	4,900	4,610	4,560	4,370	3,760
0.01	100	5,650	5,220	5,230	5,160	4,550
0.005	200	6,400	5,800	5,880	5,950	5,380
0.002	500	7,370	ng	ng	ng	ng

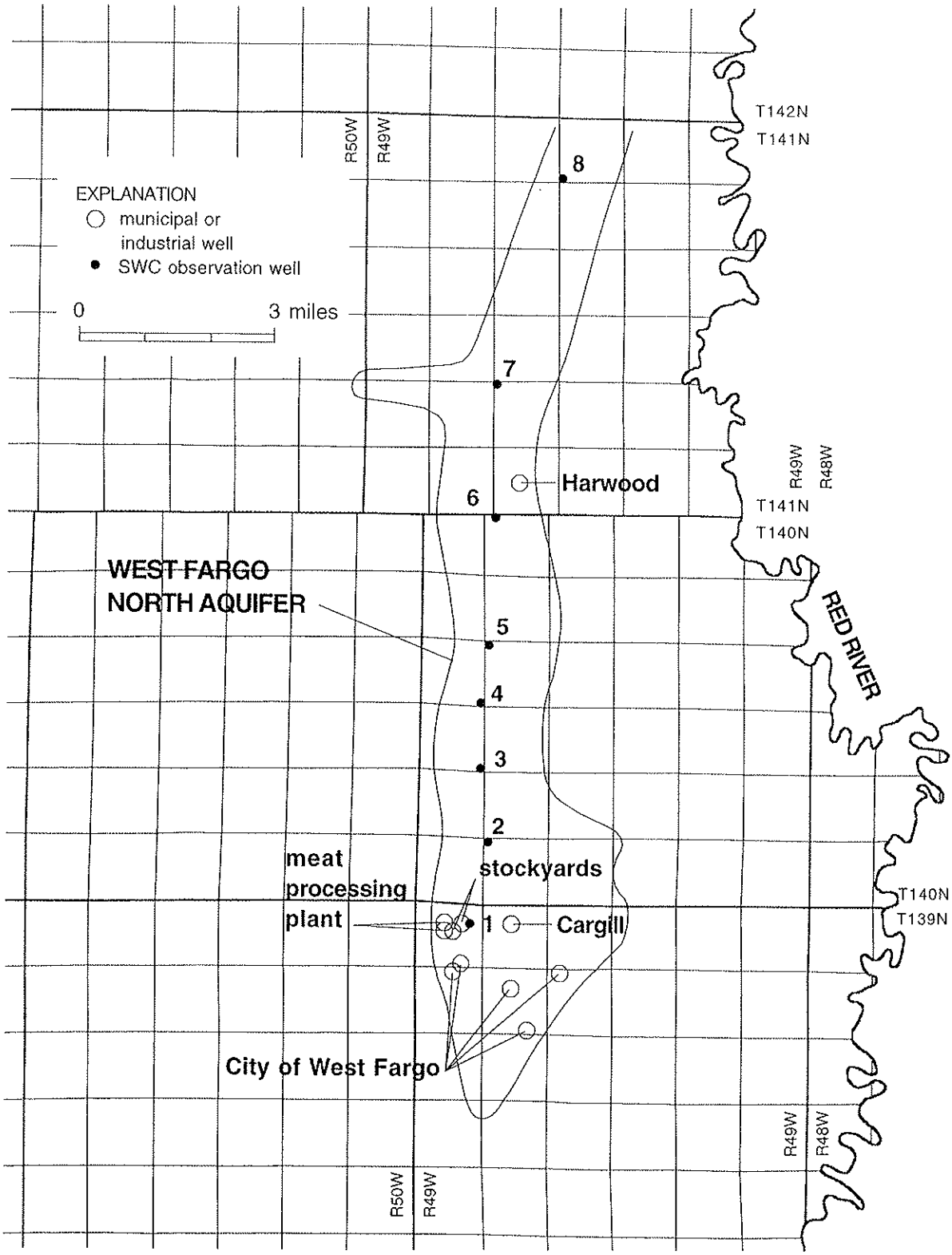
Probability of annual low discharges, post-regulation period

Non-exceedance probability	Recurrence interval (years)	Minimum average discharge (ft^3/s)								
		Number of consecutive days								
		1	3	7	14	30	60	90	120	183
0.05	20	5.25	6.23	7.81	9.27	14.5	17.1	19.6	21.9	24.9
0.10	10	8.61	9.76	11.6	13.4	17.9	21.0	23.9	26.5	30.4
0.20	5	14.3	15.6	17.6	19.8	23.0	27.0	30.4	33.6	38.6
0.50	2	28.7	30.9	32.8	35.8	36.8	43.1	48.1	52.8	61.2



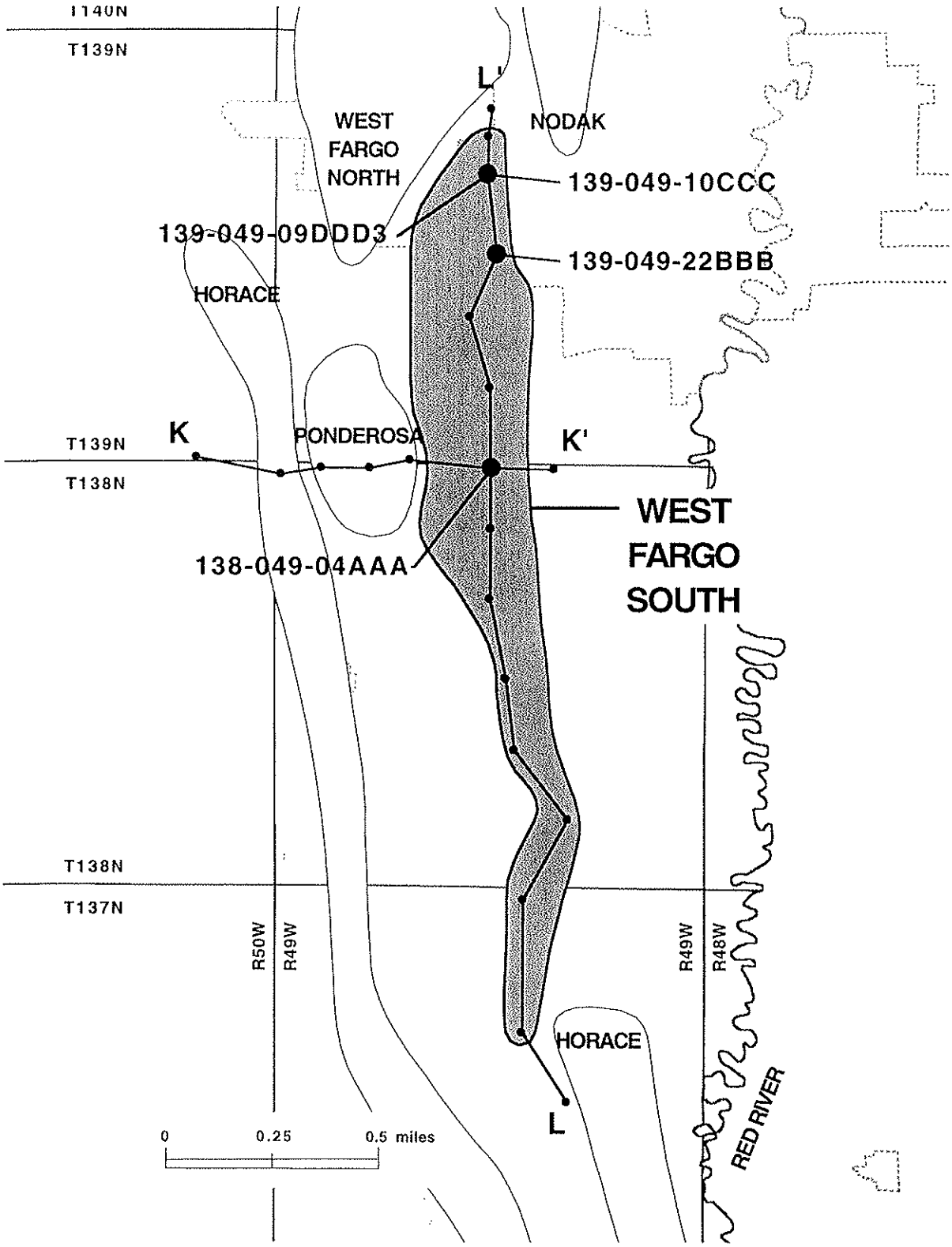
Location of West Fargo aquifer units.

Figure excerpted from *The Water Resource Characteristics of the West Fargo Aquifer System,* North Dakota State Water Commission, David Ripley, 2000.



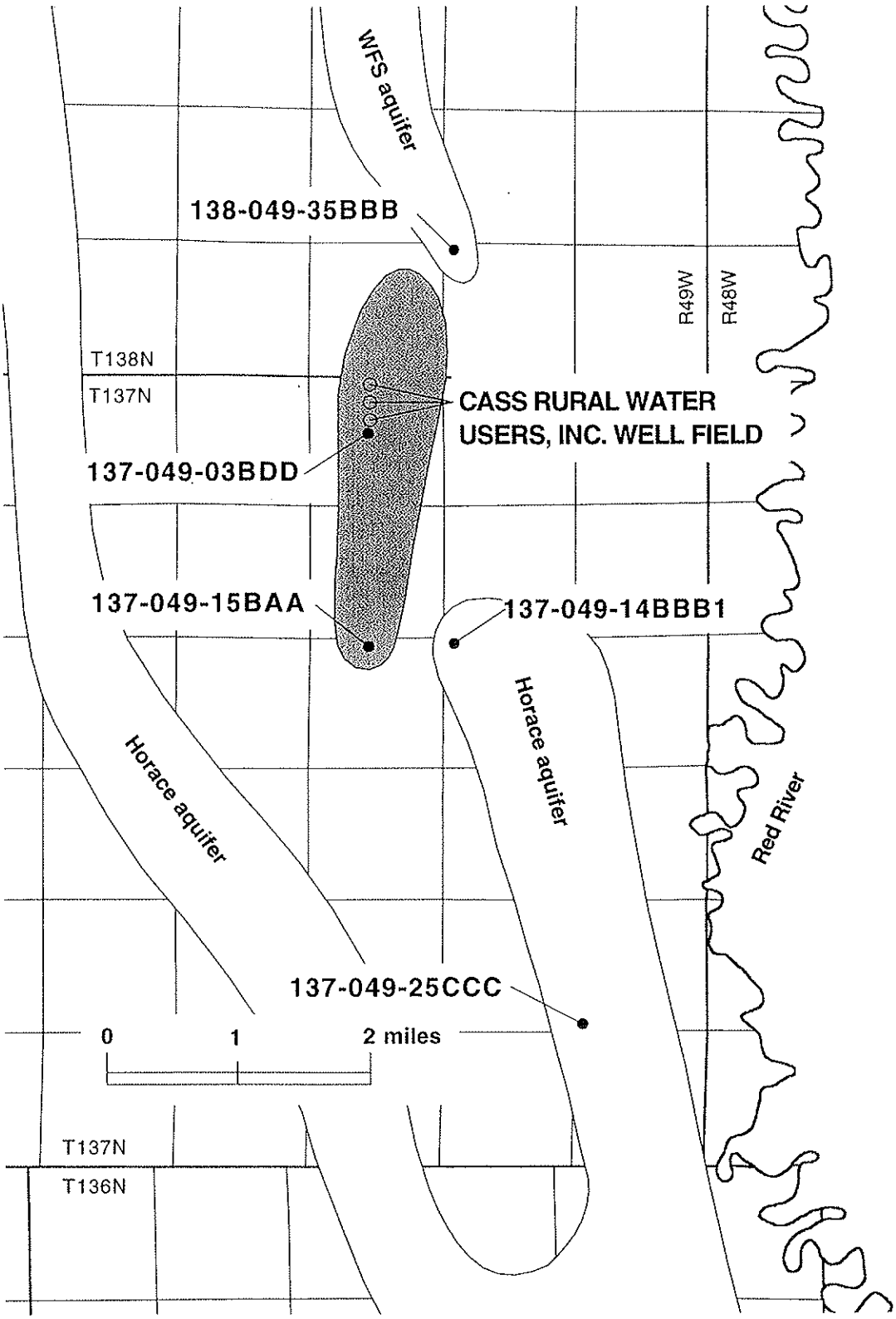
Locations of production wells and selected observation wells in the West Fargo North aquifer.

Figure excerpted from *The Water Resource Characteristics of the West Fargo Aquifer System,* North Dakota State Water Commission, David Ripley, 2000.



Location of the West Fargo South aquifer and geologic sections K-K' and L-L'.

Figure excerpted from *The Water Resource Characteristics of the West Fargo Aquifer System,* North Dakota State Water Commission, David Ripley, 2000.



Possible configuration of the south part of the West Fargo South Aquifer near Cass Rural Water User's well field.

Figure excerpted from *The Water Resource Characteristics of the West Fargo Aquifer System,* North Dakota State Water Commission, David Ripley, 2000.

b. Sheyenne River

The Sheyenne River is the second major river in the study area. Long-term mean flows range roughly from 150 to 225 cfs from upstream to downstream, and the 7-day, 50-year low flow at West Fargo is projected as 4.8 cfs under year 2030 conditions (Table 22). The low flow figure reflects diversion from the Sheyenne River of 25 cfs during drought periods (as discussed above) from a location upstream of West Fargo. The change from open ditch to pipeline for this diversion has no effect on the flow at West Fargo.

As previously noted, flow in the Sheyenne River is regulated at Baldhill Dam, upstream of the study area. The flow statistics developed in Phase 1 of the present study and cited immediately above reflect operation of Baldhill Dam to help meet Fargo-Moorhead water demands.

The water quality of the Sheyenne River is similar to that of the Red, but certain salts and metals have higher concentrations in the Sheyenne. Total dissolved solids in the Sheyenne River (Table 26) are approximately 25 percent higher than in the Red (compare with Tables 23 and 25). Sulfate, chloride, sodium, iron, and mercury are all substantially higher in the Sheyenne River.

As with the Red River, the Sheyenne River has contaminant levels well below corresponding primary drinking water standards, except for coliform bacteria, turbidity, and mercury. The average mercury concentration in the Sheyenne River, 0.004 mg/l, is double the drinking water standard, 0.002 mg/l. Concentrations in the river have ranged as high as 0.040 mg/l, or 20 times higher than the drinking water standard.

TABLE 26

STREAM WATER QUALITY SUMMARY
SHEYENNE RIVER NEAR KINDRED, NORTH DAKOTA
1975-1983

Parameter (units)	Mean	Range	Number of Samples
HAVING PRIMARY DRINKING WATER STANDARDS:			
Total Coliforms (per 100 ml)	961	10-4,200	47
Turbidity (turb. unit)	26	1.1-130	48
Arsenic (mg/l)	0.006	0.003-0.014	32
Barium (mg/l)	0.17	<0.10-0.60	31
Cadmium (mg/l)	0.001	0.000-0.002	21
Chromium (mg/l)	0.009	0.000-0.020	32
Fluoride (mg/l)*	0.3	0.1-0.5	125
Lead (mg/l)	0.007	0.000-0.025	19
Mercury (mg/l)	0.004	0.000-0.040	32
Nitrate (mg/l as N)*	0.30	0.00-1.6	102
Selenium (mg/l)	0.001	0.000-0.001	32
Silver (mg/l)	<0.001	--	28
Endrin (mg/l)	0.00000	--	5
Lindane (mg/l)	0.00000	--	5
Toxaphene (mg/l)	0.000	--	5
2,4-D (mg/l)	0.00004	0.00001-0.00007	4
2,4,5-TP Silvex (mg/l)	0.00000	--	4
OTHERS:			
Total Alkalinity (mg/l as $CaCO_3$)	232	83-340	118
Total Hardness (mg/l as $CaCO_3$)	293	115-431	126
Calcium (mg/l as $CaCO_3$)*	182	70-275	126
pH	8.0	7.3-8.5	141
Specific Conductivity (umhos/cm)	784	180-1,210	182

TABLE 26 (continued)

Parameter (units)	Mean	Range	Number of Samples
Silica(mg/l)*	18	3.9-48	125
Iron (mg/l)*	2.5	<0.01-58.	108
Magnesium (mg/l)*	27	11-42	126
Sodium (mg/l)*	62	9.5-110	126
Potassium (mg/l)*	8.5	3.8-13	125
Bicarbonate (mg/l as HCO_3)	292	110-414	81
Sulfate (mg/l as SO_4)*	146	50-240	126
Chloride (mg/l)*	31	5.7-74	126
Total Dissolved Solids (mg/l)	512	200-771	129

*Dissolved fraction.

SOURCE: Derived from data provided by U.S. Geological Survey STORET retrieval.

A close inspection of the data record reveals that elevated mercury levels were found in only 1 year out of 7 years monitored. Six years with a small number of samples (2 to 4 each year) exhibited mercury concentrations always less than 0.001 mg/l. During October 1978 through September 1979, however, 10 samples showed an average concentration of 0.011 mg/l. The cause of such elevated mercury concentrations during this 1-year period is not known. Since mercury's drinking water standard is based on its toxic properties, elevated mercury levels are a serious public health concern. Usual water treatment processes may reduce mercury levels, though they are not aimed at doing so.

As in the Red River, future water quality in the Sheyenne River can be expected to show increases in hardness, sulfate, and total solids concentrations on the order of 10 percent or less assuming modestly increased irrigation upstream of the study area.

Streamflow regulation makes the Sheyenne River a reliable source of water. The 7-day, 50-year drought flow is 4.8 cfs at West Fargo, and this flow does not include additional water diverted from the river upstream of West Fargo during drought periods. Sheyenne River water quality poses a concern for sometime-elevated mercury levels, but is otherwise fairly good for water supply.

c. Buffalo River

The Buffalo River carries a substantial mean streamflow (125 cfs at Dilworth) but is projected to have a nil 7-day, 50-year low flow under year 2030 conditions (Table 22). Flow of the Buffalo River is presently unregulated.

The water quality of the Buffalo River (Tables 27, 28, and 29) is generally similar to that of the Red and Sheyenne Rivers. The most prominent differences are substantially lower turbidity and higher alkalinity and hardness in the Buffalo River. Single total coliform measurements based on data furnished by

GE Betz

WATER ANALYSIS REPORT

MOORE ENG
West Fargo

Sampled: 19-DEC-2002
Reported: 06-JAN-2003
Field Rep: Forthun, Michael L.
91001363

	RIVER INTAKE M1227136	FORMAN RO M1227137
pH	8.4	8.0
Specific Conductance, at 25°C, µmhos	1230	2220
Alkalinity, "P" as $CaCO_3$, ppm	8.2	0
Alkalinity, "M" as $CaCO_3$, ppm	366	377
Sulfur, Total, as SO_4, ppm	291	704
Chloride, as Cl, ppm	30	101
Hardness, Total, as $CaCO_3$, ppm	469	739
Calcium Hardness, Total, as $CaCO_3$, ppm	213	517
Magnesium Hardness, Total, as $CaCO_3$, ppm	256	221
Barium, Total, as Ba, ppm	0.09	< 0.01
Strontium, Total, as Sr, ppm	0.48	1.2
Copper, Total, as Cu, ppm	< 0.05	< 0.05
Iron, Total, as Fe, ppm	0.53	0.12
Sodium, as Na, ppm	117	251
Potassium, as K, ppm	14.3	22
Aluminum, Total, as Al, ppm	1.4	1.6

GE Betz

WATER ANALYSIS REPORT

MOORE ENG
West Fargo

Sampled: 19-DEC-2002
Reported: 06-JAN-2003
Field Rep: Forthun, Michael L.
91001363

	RIVER INTAKE M1227136	FORMAN RO M1227137
Manganese, Total, as Mn, ppm	0.12	0.24
Nitrate, as NO_3, ppm	< 10	< 10
Phosphate, Total, as PO_4, ppm	< 0.4	< 0.4
Phosphate, Ortho-, as PO_4, ppm	I	< 0.2
Phosphate, Filtered Ortho-, as PO_4, ppm	0.3	
Silica, Total, as SiO_2, ppm	13.6	31
Fluoride, as F, ppm	< 0.4	< 0.4
Carbon, Total Organic, as C, ppm	10.9	2.9
Color, Apparent, Color Units (APHA)	55	
Turbidity, NTU	15.4	0.8